CHAPTER 7

ESTABLISHING COMPLETE HAZARD INVENTORIES

INTRODUCTION

If you are to protect your employees from workplace hazards, you first must understand just what those hazards are. Are you sure you know all of the potential hazards generally associated with your type of business and your specific working conditions?

A means of systematically identifying all workplace hazards would be useful. OSHA's Safety and Health Program Management Guidelines address such an inventory. The Guidelines recommend:

- Periodic, comprehensive safety, industrial hygiene and health surveys:
- Change analysis of the potential hazards in new facilities, equipment, materials and processes; and
- Routine hazard analyses, such as job hazard analysis, process hazard analysis or phase hazard analysis.

These three major actions – comprehensive surveys, change analysis and routine hazard analysis – form the basis from which good hazard prevention and control can develop. After hazards are recognized and controls are put in place, additional worksite analysis tools can help ensure that the controls stay in place and that other hazards do not appear. For a detailed discussion of these additional tools, such as inspections, employee reports of hazards, accident and incident investigations, and accident pattern analysis, you should refer to other chapters.

But first you need to understand the existing and potential hazards in your workplace.

COMPREHENSIVE SURVEYS

Comprehensive surveys are not the same as inspections. An inspection is often done by employees at the site. Comprehensive surveys should be performed by people who can bring to your worksite fresh vision and extensive knowledge of safety, health or industrial hygiene. Because there are few professional consultants equipped to do comprehensive surveys in all three areas, the best approach is to use a team consisting of three separate specialist: a safety professional, an industrial hygienist and an occupational health professional.

The occupational health professional can be a physician or a registered nurse with specialized training and experience in occupational health. A professional can assist the safety or industrial hygiene professional or do a separate health survey, depending on the circumstances at your site. For the selection criteria for occupational health professionals, see Chapter 10.

For small businesses, safety and industrial hygiene experts usually can be found in the state-run consultation service, the Wisconsin Safety Consultation Program (WiSCon). Occupational health professionals sometimes can be found at local clinics and hospitals or may be no farther away than the plant nurse. Larger businesses can contract for safety and health expertise or find it at the company or corporate level.

If you use experts from within your company be on guard for "tunnel vision," which can lead to a failure to spot hazards in areas not directly related to your firm's primary function. You will want your maintenance shop, for example, to be just as safe as your production line. We frequently find unguarded saws and grinders, non-code electrical wiring and other basic safety hazards in areas that are outside the main production process but regularly used by employees.

For the industrial hygiene survey you should, at a minimum, inventory all chemicals and hazardous materials in the plant and review the hazard communication program. For many industries, a survey of noise levels and a review of the respirator program will also be vital.

Questions to Ask Before Contracting for a Survey

To ensure that your worksite will receive the comprehensive survey envisioned by the Guidelines, you may want to ask potential surveyors or consultants certain questions:

- What type of training and experience has your prospective surveyor had?
  - How recent is it?
  - What is its scope? Is it limited to your industry only? Does it consist of only practical experience, without formal training?
  - If certified, is certification still valid or has it lapsed for lack of recent training or seminar attendance?
- Ask for references and check those where comprehensive surveys have been done recently.
- Ask references whether any OSHA inspections occurred after the survey and if so, whether any serious hazards were found that the consultant has missed.
  - Find out what tools the consultant used and what was covered.
- What kind of information will the consultant need in advance? A professional who is planning an in-depth survey will prepare by learning beforehand as much as possible about your worksite and its processes.
  - Both safety and industrial hygiene professionals will probably want to see a layout of your operations.
  - An industrial hygienist may ask for a list of the chemicals you use or the Material Safety Data Sheets (MSDSs) you have received from your suppliers and the types of processes in which you use them.
- What kind of test equipment will the consultant bring?
  - You should expect the safety professional to bring: a tape measure; a ground loop circuit tester to test electrical circuits; a multi-meter; a tic tracer (or similar equipment) to check wire or electrical equipment to see if they are energized; and a ground fault circuit interrupter tester.
  - The industrial hygienist should bring noise testing equipment and, depending upon the chemicals or other contaminants expected, sampling pumps or grab sampling devices.
- How long will the survey take?
  - It should take several times longer than a routine inspection of your worksite.
  - If the industrial hygienist does sampling, it should be the time-weighted, 8-hour or full-shift sampling to understand the overall exposure to employees.

How Will You Know the Surveyor Has Done a Thorough Job?

Here are some signs of a thorough survey:

- Safety professionals, industrial hygienists and occupational health professionals should start with your injury and illness logs and look for patterns.
  - The safety professional also may want to see other program documentation.
  - The industrial hygienist and occupational health professional will want to see your hazard communication program, and if applicable, your hearing conservation and/or respirator program.
  - The occupational health professionals will want to see your records of employee visits

to clinics, first aid stations and other sites where treatment is given for work-related illness and injury. They will want to examine records of employee training in first aid, CPR and CMT. Baseline and follow-up testing records probably will be reviewed also.

- The safety professional should start at the beginning of your process, where raw materials are brought in, and carefully go through all your processes, watching each operation and talking to employees until the point where your worksites' product is shipped out or otherwise completed. The process should include:
  - Watch how materials are handled and stored, checking the stability of storage racks and the safe storage of flammable/explosives;
  - Check the openings that expose moving parts for pinch and nip points and other hazards;
  - Check hand tools and equipment and wiring in the maintenance shop;
  - Arrange to see operations on every shift and to observe any after-hours operations, such as clean-up or forklift battery recharging;
  - Show interest in how you manage your hazard prevention and control program;
  - Open every door and look in every corner of your facility;
  - Walk around the outside of buildings to check on such things as chocks for trucks at the loading/unloading docks, forklift ramps, outdoor storage of flammable/explosives and any fueling areas;
  - Suggest target tasks for job safety analysis, especially those tasks that might involve ergonomic hazards; and
  - Assist in developing or improving your injury reduction program.
- The industrial hygienist and occupational health professional should start at the beginning of your production operation, observe all processes, talk to employees and follow the production flow to the point of shipping. They will want to:
  - Check your inventory of chemicals against what can be found in the worksite;
  - Determine what metals are used in any welding operations;
  - Check any production areas where eating or smoking is allowed;
  - Check for the possible presence of asbestos, lead carcinogens, etc;
  - If respirators are used, check whether you are using each brand properly, how each employee is fit tested, whether pulmonary function testing is done and how the respirators are cleaned, maintained, and stored;
  - Do full-shift sampling of contaminants thought to be present in order to understand the overall exposure to employees;
  - Watch the movements workers make in performing their jobs to see if there are existing or potential cumulative trauma disorders (CTDs) or other ergonomic hazards;
  - Possibly suggest processes for routine process hazard analysis; and
  - Help set up or improve regular monitoring programs for any contaminants or other health hazards found to be present.

  Note: The items above are signs of a thorough survey. They do not constitute an exhaustive list of activities you should expect.

The baseline survey should provide the basic inventory of hazards and potential hazards of your worksite. This hazard inventory will be expanded and improved by what you learn from later periodic surveys, change analysis and routine hazard analysis. However, the foundation of your inventory is the baseline comprehensive survey. Consequently, it is very important that this initial survey be done well.

Follow-up Surveys: You need periodic follow-up surveys if you are to apply the rapidly growing scientific and engineering knowledge about hazards, their prevention and control. These follow-ups also help uncover the hazards that develop as processes and procedures evolve over time.

The necessary frequency of follow-up surveys will depend upon the size and complexity of your operations.

Change Analysis: Before making changes in the worksite, analyze the changes to identify potential hazards. Anytime you bring something new into your worksite, whether it be an entirely new building, a piece of equipment, different materials or a new process, you unintentionally may introduce new hazards. If you are considering a change for your worksite, you should analyze it thoroughly beforehand. This change analysis is cost-effective in terms of the human suffering and the financial loss it prevents. Morever, heading off a problem before it develops usually is less expensive than attempting to fix it after the fact.

An important step in preparing for a worksite change is considering the potential effects on your employees. Individuals response differently to change, and even a clearly beneficial change can throw a worker temporarily off-balance – literally as well as figuratively – and increase the risk of accidents. You will want to inform all affected employees of the change, provide training as needed and pay attention to worker response until everyone has adapted.

The WiSCon program will look at plans, blueprint and photographs and will advise you on health and safety concerns.

Building or Leasing a New Facility. Even something as basic as a new facility needs to be reviewed carefully to identify hazards it might pose. A design that seems to enhance production of your product and appears delightful to the architect may be a harmful or even fatal management decision. Have safety and health experts take a careful look beforehand at all the design/building plans.

Leasing a facility that was built for a different purpose at an earlier time increases the risk of acquiring health and safety problems. You should make a thorough review of the actual facility plus the blueprints or plans for any renovations. One of the most obvious concerns in acquiring an existing facility is whether asbestos insulation is present and whether it is friable (flaking off in tiny particles). But you also may discover that something as easy to fix as a loose stair railing has gone unnoticed in the rush to renovate production areas.

Save frustration, money and lives: have expert safety and health professionals involved in the planning of any facility purchase or lease.

Installing New Equipment. An equipment manufacturer does not know how its product will be used at your worksite. Therefore, you cannot rely totally on the manufacturer to have completely analyzed and prepared controls or safe procedures for the product. Morever, if the equipment is produced in a foreign country, it may not meet clear requirements of U.S. standards and laws. Therefore, involve health and safety professionals in the purchase decision and in the installation plans.

Many companies also provide a period to test newly installed equipment. The company assigns its most experienced operators to watch for hidden hazards in the operations before full production begins. As with new facilities, the sooner flaws are detected the easier and cheaper corrections are likely to be.

Using New Materials. Before introducing new materials to your production processes, research the hazards that the materials themselves present. Also, try to determine if any hazards can occur due to the processes you plan to use with the materials.

The place to start is usually the manufacturer's Material Safety Data Sheet. An MSDS is required for all materials containing hazardous ingredients. It should arrive with each shipment. The MSDS should provide the information an industrial hygienist needs in order to analyze an ingredient which may pose a hazard, as well as the means to prevent or control it.

Some traditional materials, such as lead in paint, are dangerous to use but are replaceable with less hazardous mixtures. For other materials, you may not be able to find adequate substitutes. You may need to establish controls for the hazards these materials present.

Starting Up New Processes. New processes require workers to perform differently. Consequently, new hazards may develop even when your employees are using familiar materials, equipment and facilities. Carefully develop safe work procedures for new processes. After the operators have become familiar with these procedures, perform routine hazard analysis (discussed below) to discover any hidden hazards.

Analyzing Multiple Changes. Often a big change is composed of several smaller changes. When you start up production of a new product, you will have new equipment, materials and processes to monitor. Make sure each new addition is analyzed not only individually but also in relation to the other changes.

Once you have analyzed the changes at your worksite, add this information to your basic inventory of hazards. This inventory is the foundation from which your hazard prevention and control program is designed.

When People Change. Worker changes that have safety and health ramifications can be divided into two basic categories. The first is staffing changes. A task previously done by one worker now is being performed by someone else. The new employee may bring to the position a different level of skill from the previous jobholder. Almost certainly each will possess a different degree of experience in performing the tasks, in following the specific work rules and procedures of the site, and in interacting with nearby workers. Especially in high hazard situations, these differences should be examined and steps should be taken to minimize any increased risk, both to the new employee and to anyone affected by the change. Chapter 10 offers a variety of training and job orientation methods that will help you to ensure a safety employee transition.

The second category of worker change is the sometimes sudden, sometimes gradual change that can occur in the individual employee. The change may be related to temporary or chronic medical problems, a partially disabling condition, family responsibilities, family crisis and other personal problems, aging, or the worker's response to workplace changes. An analysis of this change, followed by physical and/or administrative accommodations to ensure safe and healthful continued performance, sometimes may be appropriate, as for example when an accident affects and employee's functioning. At other times, a less formal response will be more suitable.

It may be useful to remember that workplace hazards do not exist in a vacuum. The human element is always present, and the human condition is one of change. An effective manager will be sensitive to these changes and their potential effect on the safety and health of the individual and the company as a whole.

JOB HAZARD ANALYSIS

This is the most basic and widely used tool in routine hazard analysis. It is sometimes called job safety analysis. You begin by breaking down a job into its component steps. This is best done by listing each step in order of occurrence as you watch an employee performing the job. Next you examine each step to determine the hazards that exist or that might occur. Reviewing the jobs steps and hazards with the employee performing the job will help ensure an accurate and complete list. Manufacturer's equipment operating instructions or Material Safety Data Sheets (MSDSs) should also be considered.

Now determine whether the job could be performed differently to eliminate the hazards. Would it help to combine steps or change the sequence? Are safety equipment and other precautions

needed? If a safer way of performing the job is possible, list each new step, being as specific as possible about the new procedure. If no safer way to perform the job is feasible, determine whether any physical changes will eliminate or reduce the danger. These might include redesigning equipment, changing tools, adding machine guards, using personal protective equipment, or improving ventilation. Establishing a personal hygiene routine may be appropriate where toxic dust is a hazard.

Review these new safe work procedures with all employees performing the job. Obtaining their ideas about the hazards and proposed changes is an important part of this process. It will help ensure that your proposed changes are sensible and are accepted by the workers you are trying to protect. Many companies have experienced success in assigning the workers who perform the tasks to the job hazard analysis team.

Improvements in job methods can lead to reduced costs resulting from employee absenteeism and workers' compensation and often can lead to increased productivity. Detailed information on this important tool can be found in the OSHA Publication 3071, "Job Hazard Analysis."

PROCESS HAZARD ANALYSIS

A process can be defined as any series of actions or operations that convert raw material into a product. The process can terminate in a finished product ready for consumption or in a product that is the raw material for subsequent processes.

OSHA's Process Safety Management of Highly Hazardous Chemicals standard (Part 1910.119) defines process for the purpose of the standard as any activity involving a highly hazardous chemical, including any use, storage, manufacturing, handling or on-site movement of such chemicals, or a combination of these activities. This standard aims to protect employees by preventing or minimizing the consequences of chemical accidents involving highly hazardous chemicals.

Employers should refer to the standard and its appendices to determine if they have processes covered by the standard and to take advantage of the standard's greater detail regarding the requirement for establishing a process safety management program. Such a program includes conducting process hazard analyses. However, the concept of process safety management is relevant and useful to the full range of workplaces, not only those subject to the standard's requirements. We believe that any business aiming for a comprehensive safety and health program will benefit from conducting a process hazard analysis.

A process hazard analysis is a detailed study of a process to identify every possible hazard presented to employees. Every element of the process must be studied. Each action of every piece of equipment, each substance present, and every move made by an employee must be assumed initially to pose a hazard to employees. Process hazard analysis then is applied to show that the element either poses no hazard, poses an uncontrolled hazard, or poses a hazard that is controlled in every foreseeable circumstance.

Often the process hazard analysis will concentrate on the specialized equipment used in the process. The equipment may be used to:

- Move materials;
- Apply mechanical forces or concentrations of energy to materials (e.g., ionizing radiation, magnetic or electric fields, and lasers);
- Mix materials; or
- Bring the hold materials together and contain them, under either ambient or special conditions, for chemical or biological reactions, etc.

Processes may be either batch or continuous. Some operations may be conducted remotely. There may be special instrumentation to monitor conditions at various stages in the process. These instruments will keep the operator informed and perhaps also directly control the process or shut down operations if a hazardous or otherwise undesirable condition is approaching.

The best time for an employer to conduct a process hazard analysis is when the process is first being designed, before equipment is selected. This review, in turn, will assist you in choosing process equipment for its effective, efficient, and safe operation. Be sure to consider the equipment's capacity for confining the process within predetermined safe limits. The type, number, and location of detectors you select for monitoring the process should ensure not only productive operation but also safe operation. Remember to take into account any substance or mixture of substances that could present fire and explosion hazards.

When you have selected your equipment, the information from the process hazard analysis will help you to develop an appropriate inspection and maintenance schedule.

Remember, even when a process initially appears to be so simple that hazard analysis during the design phase seems unnecessary, it needs to be done anyway. If the process is simple, and there are no known potential hazards, then the process hazard analysis likewise will be simple and will require very little time and expense. On the other hand, if things are not as simple as they seem the analysis may reveal potential problems that might have been overlooked otherwise. Correction at this early stage will save time, money, and possible injuries and grief.

Process hazard analysis will include hazards associated with:

- Mechanical and chemical operations,
- Low and high temperature and pressure operations,
- Possible high levels of radiant energy,
- Direct contamination of employees, and
- Contamination of the air with toxic substance.

Remember that toxic substances may be the raw materials entering the process, the intermediate products, the final products, or the by-products or waste products.

Who Should Do the Process Hazard Analysis? A team approach is the best approach for performing a process hazard analysis because no one person will possess all of the necessary knowledge and experience. Additionally, when more than one person is performing the analysis, different disciplines, opinions, and perspectives will be represented and additional knowledge and expertise will be contributed to the analysis. At least one member of the team should be an employee who has experience and knowledge of the process being evaluated. (See the standard at 1910.119(e) concerning makeup of the process hazard analysis team).

Small businesses may need to hire expert consultants to assist in the development of the analysis. If you have a small business and you do not know whether your process requires a high degree of expertise, call for advice from the WiSCon office.

OVERVIEW OF THE PROCESS

Start by writing down answers to the questions contained in the Appendix 7-1worksheet. With the answers to these questions, combined with any additional information pertinent to your operation, prepare a detailed narrative report. Your report should be clear enough to be understood even to persons unfamiliar with the process.

Process Flow Chart. Unless your process is very simple, with only one or two steps, you should now prepare a diagram or flow chart of the process. The flow chart is a detailed expansion of the overview. It is prepared as a visual and verbal description of each step in the process,

clearly relating each step to the others. A careful review of the flow chart should reveal any elements not considered in the overview. For an example of a process flow chart, see Appendix 8-2.

Hazardous Substances. Examine each substance in the process: raw materials, intermediate products, final product, by-products and wastes.

Be sure to look at all activity involving substances that could produce hazardous conditions or products. Consider the potential for the air's oxygen content being reduced in any inhabited space, especially confined spaces. Study the potential hazards of each substance – toxicity, fire or explosive hazard, and others. (This is a requirement of 29 CAR 1910.1200(d). See how each substance appears in the process and in what quantity. Is each hazardous substance being handled in a way that minimizes its hazard? Could a less hazardous material be substituted?

With these answers you can plan your program of prevention and control. Take the precautions necessary to protect your workers, beginning with substitutions and engineering controls. Establish work practices and use personal protective equipment (PPE) as necessary. The topic of hazard prevention and control is covered in Chapter 8.

Equipment. Look at all the equipment, from that used to bring in the raw materials at the beginning of the process to the equipment used to move out the products, by-products and waste products at the end of the process. It must be safe not only for the operator but also for other workers nearby.

Look at the materials handling equipment throughout the process. Examine all the machines used to bend, form, cut, grind, mill, smooth, or otherwise change the surface or contours of solid materials. Look at equipment used to weld, crimp, rivet or otherwise fasten one solid piece to another.

For liquids and gases, there will be enclosed systems for transfer and storage, vessels for mixing, and reactor vessels that may be subjected to high or low temperatures and/or pressures. If there are exothermic reactions, reactions that release heat, are there adequate provisions for removing the heat? Look at any special equipment capable of producing hazardous levels of radiant energy.

Once you have determined the potential hazards, you can plan your prevention/control by using the safest equipment, implementing engineering controls and work practices, and providing and ensuring the use of PPE as necessary.

Worker Exposure. Look at each worker's locations and actions throughout the workday. With what substances and equipment does the worker interact? Does the worker perform actions that result in a hazard for the worker or others?

Employee exposures to physical agents such as microwave radiation will have to be measured with special instrumentation. Air contaminants will have to be measured to determine exposure levels. Will air contaminant levels and worker exposure rise when outside doors and windows are closed at the end of summer.

Once you know the exposures you can plan your prevention/control employing engineering controls, work practices and PPE as necessary.

See Appendix 8-3 for a process hazard analysis worksheet.

PREPARING FOR THE UNPLANNED EVENT

When dealing with high hazard chemicals or volatile explosives, it is not enough to analyze only those hazards associated with normal operations; i.e., those times when the process works as expected. Using analytical tools such as "what it," "checklist," hazard and operability study (HAZOP), failure mode and effect analysis (FMEA), or "fault-free" analysis can determine most

of the possible process breakdowns. You then can design prevention/controls for the likely causes of these unwanted events.

"What if" analysis, appropriate for relatively uncomplicated processes, starts with points in the process where something could go wrong. You should then determine what else could happen and what all possible outcomes would be.

You must plan additional prevention and controls for those possible unplanned events that could contribute to an undesirable outcome.

For more complex processes, the "what if" study can best be organized through the use of a "checklist." Aspects of the process are assigned to analysis team members with the greatest experience or skill in those areas. Operator practices and job knowledge are audited, the suitability of equipment and materials of construction is studied, the chemistry of the process and the control systems are reviewed, and the operating and maintenance records are audited.

Hazard and operability study is a method for systematically investigating each element of a system to uncover ways in which important parameters can deviate from the intended design conditions, and as a result, can create hazards and operability problems. Typically, an analysis team studies the piping and instrument diagrams (or plant model). The team analyzes the effects of potential deviations from design conditions in, for example, flow, temperature, pressure and time. The team then assesses the system's existing safeguards, the causes of a potential for system failure and the requirements for protection.

Failure mode and effect analysis is a methodical study of component failures. This review starts with a diagram of the process and includes all components that could fail and conceivably affect the safety of the operation. Typical examples are instrument transmitters, controllers, valves, pumps and rotometers. The components are listed on a data tabulation sheet and individually analyzed for their potential mode of failure, the effects of failure, detection methods and other factors. The last step in the analysis is to analyze the component data and develop recommendations for risk management.

In "fault-tree" analysis you start with an undesirable outcome that is possible, even if highly unlikely, given the potential hazards involved in your process. Then you trace back into the process to identify all possible events or combinations of events that would have to occur to produce that outcome. Since this information is graphically represented using logic symbols in a determined sequence of events, you then can design prevention/controls to make it impossible or nearly impossible for them to occur.

For additional information on methodologies, see OSHA's Process Safety Management of Highly Hazardous Chemicals standard and "Process Safety Management - Guidelines for Compliance."

UPDATING THE PROCESS HAZARD ANALYSIS

After completion of the initial process hazard analysis, the analysis should be updated at least every 5 years to ensure that it is consistent with the current process. This update is required for businesses covered by the standard and the analysis must be revalidated by a team meeting the standard's requirements.

INVOLVING WORKERS IN ESTABLISHING THE INVENTORY

Whenever you can, use the special knowledge your workers have gained from their close involvement with equipment, materials and processes. You should encourage your employees to communicate openly with the professionals who do the comprehensive surveys. Workers frequently participate in change analysis of new equipment and/or processes because of their valuable insights into how things really will work. As mentioned above, many companies regularly include hourly operators in job hazard analysis. Employees can plan a similar role in

process hazard analysis. In addition to the benefit that you receive from their insights, they also profit. Greater understanding of hazards, prevention and control helps them do a better job of protecting themselves and their co-workers.

USING THE INVENTORY OF HAZARDS

You will use the surveys and analyses we have described to plan a program of hazard prevention and control. Chapter 8 explains this program. Briefly, you should prevent hazards by substituting less hazardous materials or equipment whenever possible. Engineering controls that distance the worker from the hazard are the next best option. For the remaining hazards, design safe work practices, train your workers adequately in these practices and enforce them consistently. Use personal protective equipment where needed. In some rare instances, you may also need to establish administrative controls, such as worker rotations or more frequent work breaks.

SUMMARY

Establishing a complete hazard inventory is not as complicated as it may sound. It begins with having safety and occupational health experts conduct a comprehensive survey of your worksite to determine the existing and potential hazards. Periodic surveys, done at intervals that make sense for the size and complexity of your worksite, will bring into play any new engineering or scientific knowledge of hazards and their prevention. They also can help find new hazards that have evolved along with changing work procedures over time.

Change analysis prevents expensive problems before they occur. Individuals who are knowledgeable in worker health and safety and help in designing and plan for changes in your worksite. Change analysis uses elements of routine hazard analysis appropriate to the type of change being contemplated.

Routine hazard analysis also adds to your inventory. It enables you to control hazards that develop in work procedures or within processes, or that occur because of changes in the phases of the operation.

The tools and approaches used in the various types of hazard analysis tend to overlap. This overlapping helps ensure total coverage and a more comprehensive inventory on which to base your prevention program.

Involving your employees in the effort to inventory hazards is sure to pay off. Hazard surveyors will benefit from workers' practical knowledge. And employees will be better able to protect themselves and others as they become more knowledgeable about workplace hazards, prevention and controls.

When assessing workplace hazards do not overlook the human element. Whenever one employee is replaced by another the difference in skill and experience can mean increased risk to both the new worker and his/her co-workers. Many factors can affect an employee's ability to function; as an example, changes in an employee's health or personal life may affect work performance, and in turn, the level of workplace safety and health. These changes can either be sudden or gradual. A manager needs to be sensitive to these changes and willing to provide training and orientation, physical and administrative adjustments, or other accommodations.

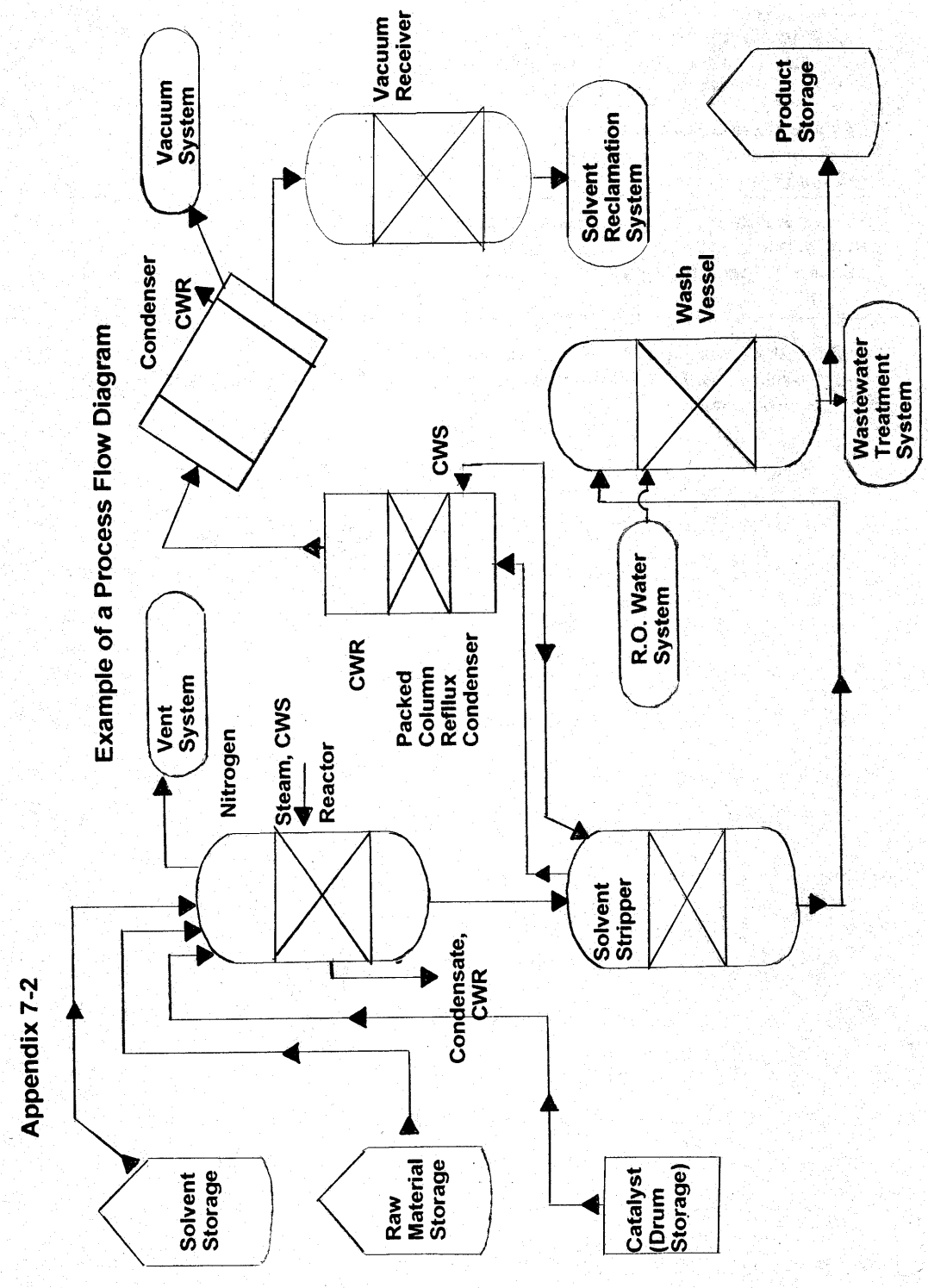
APPENDIX 7-1

PROCESS OVERVIEW WORKSHEET

Begin your process hazard analysis by writing down answers to the following questions:

1. What kind of process is it? Mechanical? Chemical? Biological	
2. What is the product?	
3. What is the rate of production?	
4. What raw materials will be used? How much?	
5. Will there be intermediate products? Their quantities?	
6. Will there be waste materials that will be a problem because of their toxicity and/or their quantity?	
7. Does this process pose inherent hazards that suggest that you should look for a safer way to product the product?	
8. Have there been previous incidents involving this process that had a potential for catastrophic consequences in the workplace?	
9. Is the process sited where it could be affected by a failure in nearby processes or where its failure could affect other processes?	
10. What kinds of equipment are used in the process? Is other, safety equipment available?	
11. Is there sufficient and reliable monitoring and control equipment? Is it fail-safe in all instances?	
13. Where employees work directly with substances and equipment, are their activities as safe as possible?	
14. Are there points in the process where workers' exposure to hazards could be reduced?	
15. Could emergency situations develop? How many unexpected events could happen at the same time? What would result?	
12. What are the various workers' roles?	

Combine the above questions and answers and any added information that you believe pertinent into a detailed narrative report. This will be the basis for your process flow chart.


Example of a Process Flow Diagram
Appendix 7-2
Vacuum System
Vacuum Receiver
Condenser CWR
Solvent Reclamation System
Product Storage
Wash Vessel
Wastewater Treatment System
CWS
Vent System
Nitrogen
Steam, CWS
Reactor
CWR
Packed Column Reflux Condenser
R.O. Water System
Solvent Stripper
Condensate, CWR
Solvent Storage
Raw Material Storage
Catalyst (Drum Storage)

APPENDIX 7-3

PROCESS HAZARD ANALYSIS WORKSHEET

1. Name the process. _____

2. Give the date the operations began. _____

3. Write a short description of the process. _____

_____

_____

_____

4. Conduct an overview, write a narrative and attach it to this form. (See Appendix 7-1). Date completed?_____

5. Prepare process flow chart and attach. (See sample, Appendix 7-2).
Date completed?_____

6. For each step in the process as shown on your flow chart, identify and record on the reverse side of this sheet each:

   a. hazardous substance,

   b. piece of equipment that presents a hazard, and

   c. employee operation that may be hazardous.